

Cryptachne E.J.Thomps. (Poaceae: Panicoideae: Cleistochloinae), a new genus for Queensland with three new species

E.J. Thompson

Summary

Thompson, E.J. (2022). *Cryptachne* E.J.Thomps. (Poaceae: Panicoideae: Cleistochloinae), a new genus for Queensland with three new species. *Austrobaileya* 12: 26–58. The new genus *Cryptachne* E.J.Thomps., endemic to Queensland, is delimited and described. Three new species, all formerly included with phrase names in *Dimorphochloa*, *Cryptachne columboola* E.J.Thomps., *C. duaringa* E.J.Thomps. and *C. trinerva* E.J.Thomps., are described with illustrations of both macro and micro morphology. *Cryptachne* is closely related to *Calyptochloa* differing in the tufted growth habit, racemose terminal inflorescences with spikelets that have a lower lemma subequal to upper lemma, and axillary spikelets with an elaiosome on the lower lemma. The three new species all have restricted distributions in habitat types associated with lancewood dominated ironstone jump-ups; they are suggested to warrant Endangered or Critically Endangered conservation status.

Key Words: Poaceae; Panicoideae; Cleistochloinae; Calyptochloa; Cryptachne; Cryptachne columboola; Cryptachne duaringa; Cryptachne trinerva; flora of Australia; flora of Queensland; amphigamy; chasmogamy; cleistogamy; anatomy; elaiosome; micromorphology; spikelet dimorphism; new genus; new species; taxonomy; identification key

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Introduction

The form of reproductive dimorphism found in the Australian endemic grass subtribe *Cleistochloinae* E.J.Thomps. (subfamily Panicoideae), involves plants having two types of inflorescences in separate places (amphigamy), viz. terminal and axillary, with spikelet dimorphism (Thompson 2021c, 2022b). Spikelets in the terminal racemes or reduced spike-like panicles are usually wholly chasmogamous (flowers in terminal inflorescences that open to release the stigmas and anthers and thereby potentially cross-fertilise) and morphologically differentiated from spikelets in reduced racemes in the leaf axils. The axillary spikelets are cleistogamous where the flowers are obligately self-fertilized and never open.

Cleistogamy is found in c. 3% of grass species and c. 10% of the genera worldwide, and 14% of the species and 30% of genera in

Australia (Campbell *et al.* 1983; Thompson 2021c). Conversely, the typical grass has only chasmogamous flowers. Anther dimorphism is shared by all species in *Cleistochloinae* with the axillary cleistogamous spikelets having much smaller anthers than the chasmogamous ones in the terminal inflorescences.

The type of dimorphic reproductive system found in the *Cleistochloinae* can also be found in some North American grasses, although spikelet morphology is distinctly different across the genera. Chase (1918: 255) noted that “Often, if their source was unknown, they would not be placed in the same tribe”, in reference to the American genera.

Calyptochloa C.E.Hubb., *Cleistochloa* C.E.Hubb., *Dimorphochloa* S.T.Blake and *Simonachne* E.J.Thomps. comprise the *Cleistochloinae* (Thompson & Fabillo 2021;

Thompson 2021b, 2021c, 2022b). Molecular and morphological datasets generated phylogenetic and phenetic analyses of this group (Thompson & Fabillo 2021; Thompson 2021c). *Dimorphochloa* appears to be not monophyletic based on these initial analyses (Thompson & Fabillo 2021); however, more extensive molecular sampling is still required of extra-Australian taxa, before a final classification can be achieved combining both datasets. *Dimorphochloa rigida* S.T.Blake and three undescribed species that have been included in *Dimorphochloa* with phrase names, represent two groups respectively, on the basis of multiple morphological characters.

The undescribed species previously assigned to *Dimorphochloa*, have closest affinity to *Calyptochloa* (Thompson & Simon 2012; Thompson & Fabillo 2021; Thompson 2021b). *Calyptochloa* differs in several morphological characters including a stoloniferous growth habit, relative length of upper lemma of the chasmogamous spikelets and the lower lemma of the cleistogamous spikelets having an elaiosome (**Fig. 1**). They also differ from *Dimorphochloa rigida*, as that species has a rhizomatous habit and rigid cane-like culms, absence of a contraligule, cleistogamous and chasmogamous spikelets similar, with the former apical on subordinate leafy branches of culms separate from the chasmogamous spikelets. By contrast, the three undescribed species are distinct in the combination of a tufted growth habit, the indumentum composition on the upper glumes and lemmas of the terminal spikelets, and the lower lemmas of the axillary spikelets having an elaiosome (**Table 1**).

The aim of this paper is to describe a new genus *Cryptachne* E.J.Thomps. to accommodate the undescribed species currently known as *Dimorphochloa* sp. (Charters Towers E.J.Thompson+ CHA554), *D. sp.* (Miles E.J.Thompson EJT906) and *D. sp.* (Mt Cooper R.J.Cumming 18623) (Thompson 2021a, 2022a). The three species of *Cryptachne* have been recorded from relatively arid, subtropical habitats usually composed of *Acacia* woodland (especially

Acacia shirleyi Maiden – lancewood), on hilly terrain with shallow to skeletal well-drained soils. They occur in eastern Australia over the latitudinal range 20–26° (**Fig. 2, Map 1**). All species occur on landscapes associated with ironstone jump-ups (Cainozoic duricrusts) (QRE 2020) and the allied grass *Cleistochloa subjuncea* C.E.Hubb. is usually dominant in the ground layer.

Materials and methods

Observations of leaf, culm and spikelet morphology of the species of *Cryptachne* and some superficially similar species of *Cleistochloa* and *Dimorphochloa* were made using imagery, herbarium specimens and fresh samples taken from cultivated plants. Plants were cultivated in pots under nursery conditions in Brisbane, Australia from 2013–2021. Nursery stock was initially grown from *ex situ* plants and additional stock was propagated from caryopses and stolons that readily root at the nodes after rain and humid weather in summer.

Data used in this paper were obtained from the 161-character list and data matrix provided by Thompson (2021c). The categories of characters covered include growth habit, culms and leaves, inflorescence type, and terminal and axillary spikelet macromorphology. Spikelet micromorphology included glumes, paleas, stigmas and caryopses. Micromorphological characters also included those of leaves and culms.

Habitat descriptions are provided in terms of Regional Ecosystems as defined by the Queensland Government (QRE 2020).

Nomenclature and terminology

Botanical nomenclature follows Brown (2022).

General botanical terminology relevant to grasses, follows Harris & Harris (1994), Beentje (2010) and Thompson (2021b). Terminology relating to inflorescences and spikelets follows Tothill & Hacker (1983), Jacobs *et al.* (2008), Gibson (2009) and Thompson (2021c). The spikelet is viewed here as a reduced inflorescence consisting of

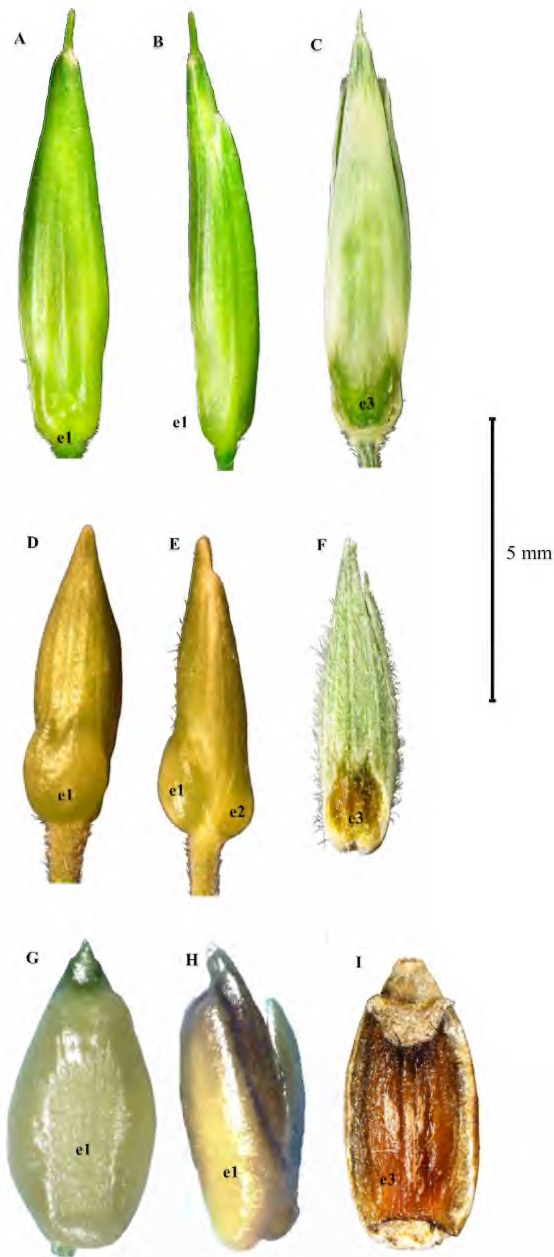


Fig. 1. Elaiosomes on fresh and dry cleistogamous spikelets of taxa in subtribe *Cleistochloinae*. A–C. Lower lemma of *Cryptachne trinerva*. A–C from Thompson MOR796 (BRI). D–F. Lower lemma and upper glume of *Dimorphochloa rigida*. D & E from Thompson MOR475 & Edginton (BRI). F from Thompson EJT958 & Simon (BRI). G–I. Lower lemma of *Cleistochloa subjuncta*. G & H from Thompson MOR710 (BRI). I from Thompson HUG815 & Simon (BRI). e1 fresh on lower lemma; e2 fresh on upper glume; e3 dry on lower lemma.



Fig. 2A. Growth habit and habitat of *Cryptachne*. A. *C. trinerva* in low woodland of *Acacia shirleyi* (lancewood) on lateritic jump-up. B. *C. columboola* in woodland of *Eucalyptus fibrosa* on sandstone. Photos: E.J. Thompson. *Cryptachne* indicated by black arrow, white arrow indicates the superficially similar *Cleistochloa subjuncea*.



Fig. 2C. Growth habit and habitat of *Cryptachne duaringa* in lancewood woodland on lateritic slope. Photo: E.J. Thompson. *Cryptachne* indicated by black arrow.

bracts subtending one or more florets (Tothill & Hacker 1983; Kellogg 2006; Endress 2010). Terminology relating to grass anatomy and micromorphology follows Ellis (1976, 1979), Watson & Dallwitz (1992) and Dengler *et al.* (1994).

Imagery

Photographs were taken using light microscopes to study anatomical and micromorphological characters, *viz.* spikelets using a Nikon SMZ25 binocular microscope with Nikon DS-R1 camera. The resultant images were viewed using NIS-Elements BR software (ver. BR 5.11.000 64-bit, USA; Laboratory Imaging (<http://www.lim.cz>, accessed 15 December 2019)). Stigmas and sections of leaves and culms were examined using a Leica DMLB compound binocular microscope fitted with a digital camera and images were viewed using ToupView software (ver. x64 4.7.14326.20190401, China; Touptek; <http://www.touptek.com>, accessed 20 September 2019).

Scanning electron micrographs (SEMs) were obtained without sputter coating (Phenom G2 5keV SEM with backscatter detector).

Data acquisition and classification of morphological characters

The freehand sectioning method described by Thompson (2017), and modified from Frohlich (1984), was used to obtain transverse sections of leaves and inflorescence culms. For each species, sections of leaves and culms were obtained from fresh material of cultivated plants.

Micromorphology of the abaxial leaf surface was studied from replicas from fresh leaves using the method described by Hilu & Randall (1984) and SEMs.

Anatomy and micromorphology of leaves and culms were studied with respect to characters such as stomata, silica bodies and microhairs (De Wet 1960; Metcalfe 1960; Twiss *et al.* 1969; Ellis 1979; Renvoize 1987; Watson & Dallwitz 1992; Siqueiros-Delgado & Herrera-Arrieta 1996; Piperno & Pearsall 1998; Krishnan *et al.* 2000; Siqueiros-Delgado 2007; Lu *et al.* 2009; Jattisha & Sabu 2015).

Observations of micromorphology were made from SEMs of lower lemmas, upper lemmas and upper paleas. Silica bodies, stomata, epidermal long cell walls, microhairs and macrohairs were classified using the

terminology of previous authors (Hsu 1965; Jirasek & Jozifova 1968; Ellis 1979; Valdes-Reyna & Hatch 1991; Snow 1996; Acedo & Llamas 2001; Liu *et al.* 2010; Mashau *et al.* 2015; Olova *et al.* 2016; Neumann *et al.* 2017).

Images of fresh and dry lodicules and stigmas were obtained using light microscopy. Lodicules were classified as plicate or non-plicate (Hsu 1965; Jirasek & Jozifova 1968; Guedes & Dupuy 1976). Stigma macromorphology was classified by the position of emergence from the spikelet,

the outline shape of the branching and colour. Micromorphology was examined using characteristics of the lobes including shape of apex, relative length and tilt (Thiele *et al.* 1996).

Caryopsis and embryo morphology (including characters relating to hilum, scutellum and epiblast, embryo, spermatid and stylopodium) were observed and classified with previously used terminology (Kennedy 1899; Reeder 1957; Brown 1959, 1960; Watson & Dallwitz 1992; Klak 1994; Kosina 1995; Snow 1998; Liu *et al.* 2005; Liu *et al.* 2015).

Taxonomy

Key to the genera of subtribe *Cleistochloinae* (modified from Thompson (2022b))

- 1 Spikelets from the two types of inflorescences similar 2
1. Spikelets from the two types of inflorescences strongly dimorphic 3
- 2 Plants stoloniferous; axillary racemes usually comprising four cleistogamous spikelets **Simonachne**
2. Plants rhizomatous with wiry, erect tufted culms; cleistogamous spikelets apical on leafy subordinate branches, usually solitary **Dimorphochloa**
- 3 Upper lemmas awned; cleistogamous spikelets adaxial 4
3. Upper lemmas mucronate; cleistogamous spikelets abaxial **Cleistochloa**
- 4 Plants stoloniferous; upper lemma much shorter than lower lemma **Calyptochloa**
4. Plants tufted; upper lemma subequal to lower lemma **Cryptachne**

Cryptachne E.J.Thomps., **gen. nov.**

Allied to *Calyptochloa* C.E.Hubb. and differing in the tufted growth habit, the indumentum on the upper glumes and lemmas of the terminal spikelets, and the lower lemmas of the axillary spikelets with an elaiosome. **Typus:** *Cryptachne trinerva* E.J.Thomps.

Tufted perennials sometimes with decumbent stems rooting at the nodes. Culm with pith. Internodes appressed pubescent. Leaf sheaths pilose with simple tuberculate-based hairs, one margin pilose. Ligule and contraligule a fringe of hairs. Leaf blades lanceolate, base truncate, pseudopetiolate, both surfaces pilose; proximal portion of margins white, ciliate with simple tuberculate-based hairs, one margin undulate. Inflorescences of

two types in different parts of the plant (amphigamous); terminal racemes and axillary racemes with 1 to 2 spikelets partly concealed by the leaf sheath. Axes of inflorescence branches lacking pulvini. Pedicels scabrid, straight; apex a shallow cup with thin walls. Spikelets dimorphic. Spikelets from terminal inflorescences chasmogamous, adaxial, slightly dorsally compressed, elliptical in outline; apical ones longer than laterals, disarticulating below the glumes. Glumes unequal; lower glume much reduced; upper glume elliptical, 5-veined, convex, cartilaginous, villous in lower two-thirds with long, straight, mostly appressed, tubercular-based simple macrohairs, apex truncate; margin flat hyaline. Lower floret sterile; lemma 7-veined linear to lanceolate, convex, cartilaginous, nerves smooth, indumentum

not exceeding the apex of the spikelet, villous throughout, apex acute, similar in shape, size and type of indumentum to upper glume; palea absent. Upper floret bisexual; upper lemma shorter than to subequal to lower lemma, 3-veined, chartaceous, body glabrous, minutely longitudinally ridged with papillae; margins hyaline, apex with flattened cilia; awned; germination lid a crescent-shaped depression; palea obscurely 2-veined, apex acute, similar texture and surface to lemmas. Lodicules 2, free, triangular-flag shaped. Anthers 3. Caryopsis slightly dorsi-ventrally compressed, loosely clasped by upper lemma and palea; hilum punctiform. Spikelets in axillary inflorescences cleistogamous; spikelets occurring in either of three combinations: (a) sessile to subsessile or pedicellate, sessile spikelets usually shorter than the pedicellate ones; (b) paired, with one sessile and the other pedicellate; (c) sessile or paired spikelets at nodes, apical one pedicellate. Pedicels mostly puberulous with short simple hairs, straight; apex shallow cup-shaped, scabrid. Spikelets elliptical, adaxial, smooth, laterally compressed; concealed within a coriaceous convolute leaf sheath at up to several culm internodes in succession from immediately below terminal inflorescence; culm bowing and exerting from sheath as spikelet matures with sheath partially gaping, leaf and then leaf sheath disarticulating at maturity with spikelet enclosed. Lower glume absent or vestigial. Upper glume shorter than the spikelet, elliptic, shallowly convex, chartaceous, glabrous except at base, 3-veined, apex obtuse. Lower floret sterile; boat shaped, two-keeled, cartilaginous, glabrous, 5-veined, apex truncate, basal elaiosome present; palea absent. Upper floret bisexual; lemma lanceolate, convolute, cartilaginous, base hirsute, 5–7-veined, apex acute to attenuate, awned; palea much shorter than lemmas, convolute, cartilaginous, 4-veined, glabrous, apex acute to attenuate. Anthers 3. Caryopsis ellipsoid, slightly dorsi-ventrally compressed; scutellum slightly less than half the length of the caryopsis; hilum elliptical. Pedicellate spikelet similar to sessile spikelet but longer, adaxial; exposed at maturity; pedicel puberulous. Caryopsis slightly dorsi-ventrally

compressed, loosely clasped by upper lemma and palea, larger than chasmogamous; hilum punctiform.

Three species; endemic to southern to central, subcoastal areas of eastern Queensland.

Notes: *Cryptachne* differs from the other genera in *Cleistochloinae* by a combination of morphological characters (**Table 1**). The growth habit of all species of *Cryptachne* is tufted and lacking rhizomes, but in summer during humid, rainy periods, plants produce decumbent stems that root at the nodes. In the field, plants resemble the tufted habit of *Cleistochloa* as opposed to the stoloniferous form of *Calyptochloa* and *Simonachne*.

Caryopses have only been seen in cultivated plants.

Fresh lodicules of *Cryptachne* are similar to those in other taxa of *Cleistochloinae* with asymmetrical lobes. Dry lodicules broadly resemble the fresh ones, although reduced in size (**Fig. 3**).

Etymology: The genus name is derived from the Greek *kryptos* (hidden) and *achne* (scale) in reference to the clandestine axillary spikelets enveloped by the leaf sheaths.

Micromorphology

Stigma and anther morphology: Stigmas emerge midway along the spikelet. Stigma lobes are relatively long for species in *Cleistochloinae*. The lobes are appressed to the stigma branch axis with narrow rounded apices. Cleistogamous anthers are about half the length of the chasmogamous ones (**Fig. 4**).

Micromorphology of the lemmas and palea: Upper lemmas and paleas of cleistogamous spikelets with “beaked type” to truncate-shaped papillae, irregularly spaced between minute narrow ridges. Upper lemmas and paleas of chasmogamous spikelets with irregularly spaced dome-shaped papillae, minute ridges absent (**Fig. 5**).

Abaxial leaf blade epidermis: Costal/intercostal zonation conspicuous. Papillae absent. Costal long cells rectangular; anticlinal walls of intercostal long cells Ω-shaped. Anticlinal walls of intercostal long

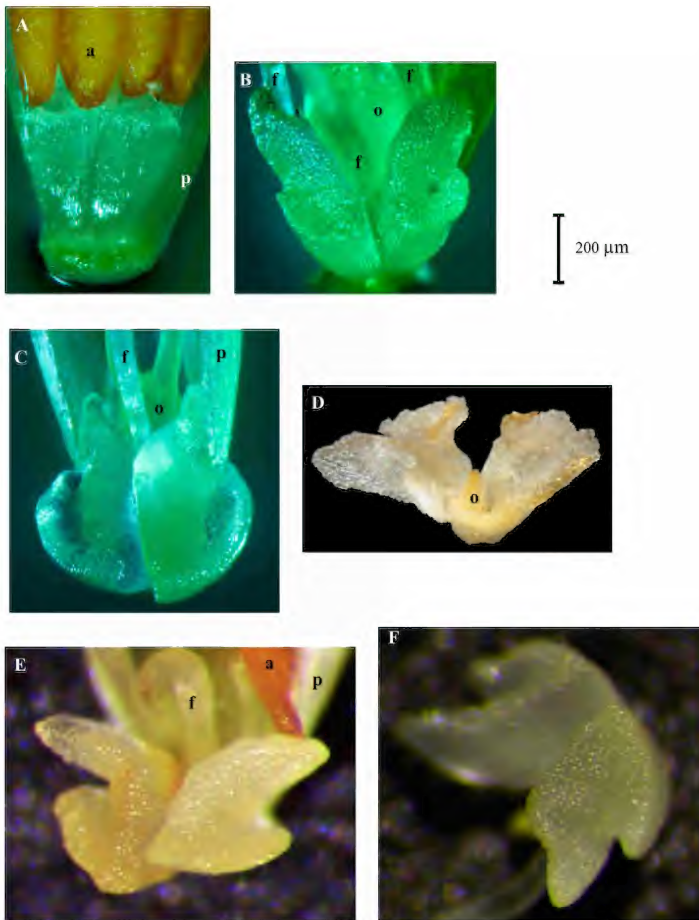


Fig. 3. Lodicules of taxa within *Cleistochloinae* demonstrating variation, *Cleistochloa subjuncea*: A & B. fresh, *in situ*. *Cryptachne duaringa*: C. fresh, *in situ*. D. dry, *ex situ*. *Calyptochloa johnsoniana*: E. fresh, *ex situ*. *Dimorphochloa rigida*: F. fresh, *ex situ*. A & B from Thompson MOR710 (BRI). C & D from Thompson MOR822 (BRI). E from Thompson MOR799 (BRI). F from Thompson MOR762 (BRI). Photos: E.J. Thompson. **a** anther; **f** filament; **o** ovary; **p** palea.

cells moderately undulating, often irregular with short wave-length (*cf.* Ellis 1979). Stomata 33–36 μm long with parallel-sided subsidiaries, in single rows separated by 6–8 files of long cells. Bicellular microhairs 50–70 μm long, proximal cell longer than distal, common. Silica bodies in 3–4 rows, bilobate, 14–20 μm long, abundant. Hooks present. (Figs. 6 & 7).

Transverse section of leaf blade: C_3 ; XyMS+. Mesophyll without radiate chlorenchyma; adaxial palisade present. Midrib not prominent; with a double bundle sheath; outer complete ring of parenchyma cells and partial inner ring of thick-walled cells with adaxial arc of clear parenchyma cells. Bulliform cells in discrete regular groups, in simple fans. Sclerenchyma accompanying all vascular bundles as adaxial strands and abaxial girders. (Fig. 8).

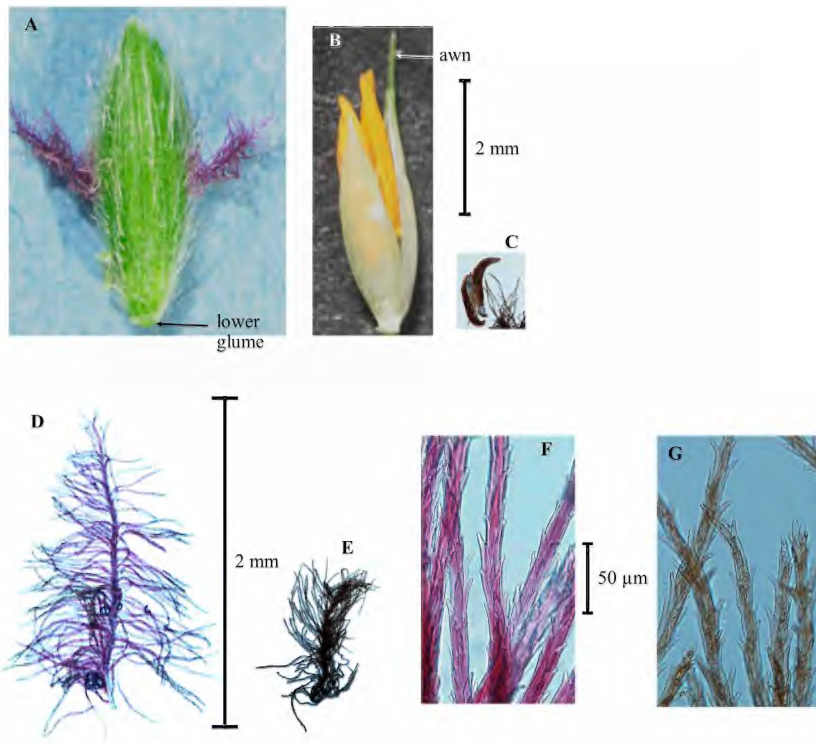


Fig. 4. Anthers and stigmas of *Cryptachne columbola*. A, B, D & F. from chasmogamous (CH) spikelet from terminal raceme. C, E & G. from cleistogamous (CL) axillary spikelet. A. adaxial view showing stigmas emerging mid-way along spikelet. B. upper floret showing CH anthers. C. CL anthers. D. CH stigma. E. CL stigma. F. CH stigma. G. CL stigma. All from Thompson *EJT906 et al.* (BRI). Photos: E.J. Thompson.

Transverse section of culm: Culm examined *c.* 0.4 mm in diameter. Vascular bundles with a ring of clear parenchyma; three sizes in separate circles, smallest to the periphery. Outer smallest vascular bundles adjacent to radial girder sclerenchyma and imbedded in large-celled sclerenchyma. Chlorenchyma in rectangular blocks, 2–4 cells deep by up to 12 cells wide; cells with regular size and shape, slightly radially oblong. Inner ground tissue consisting of large thin-walled cells (**Fig. 9**).

Surface of inflorescence culm: Hispid with simple hairs to 0.2 mm long, muriculate with hooks and scabridulous with prickles. Stomata frequent, similar to those on the abaxial leaf surface. Bicellar microhairs, 50–70 μm long, common. Silica bodies absent. (**Fig. 10**).

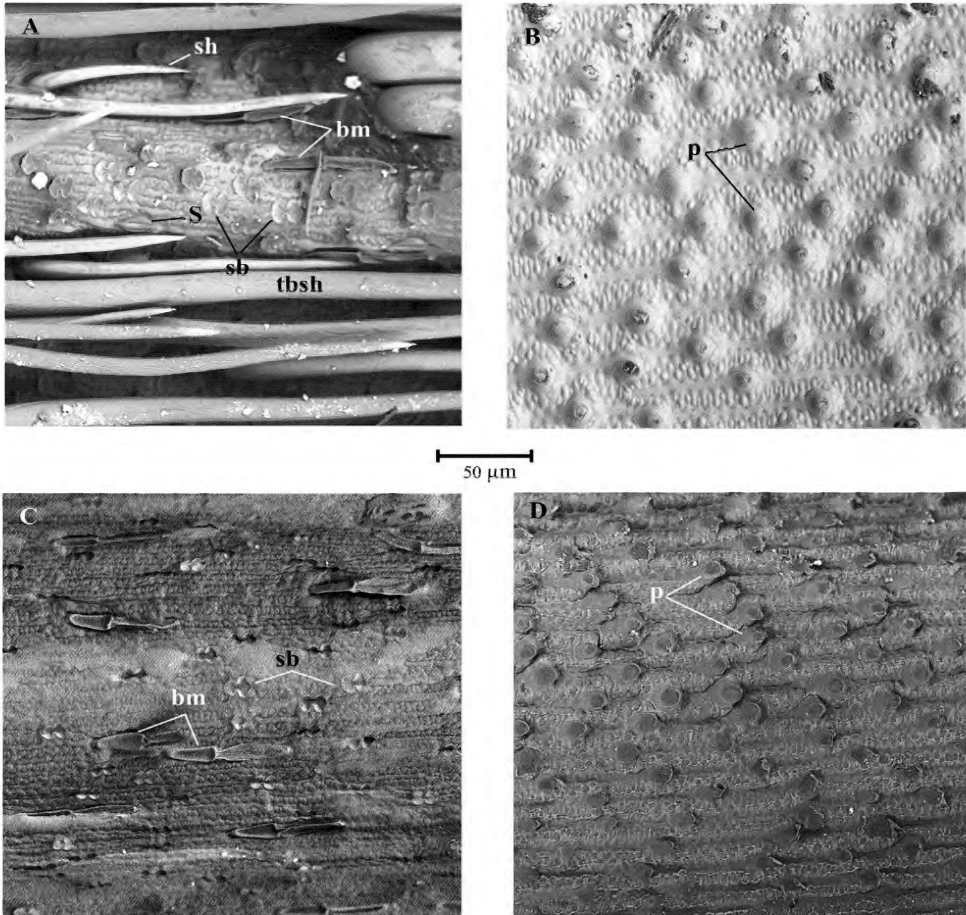


Fig. 5. Scanning electron micrographs of surface of lower lemmas of *Cryptachne trinerva*. A & B. chasmogamous spikelet. A. lower lemma. B. upper lemma. C & D. cleistogamous axillary spikelet. C. lower lemma. D. upper lemma. From Thompson *CHA555 & Turpin* (BRI). Micrographs (captured at $\times 1000$): E.J. Thompson. **bm** bicellular microhair; **tbsh** tuberculate-based simple hair; **p** prickle; **S** stomata; **sb** silica body; **sh** simple hair.

Key to the species of *Cryptachne*

- 1 Apical spikelets in terminal inflorescences, mostly > 5 mm long; spikelets from upper leaf axils mostly single, sessile, > 7 mm. **C. trinerva**
- 1. Apical spikelets in terminal inflorescences, mostly *c.* < 5 mm long; axillary spikelets mostly pedicellate only, < 7 mm long **2**
- 2 Spikelets in terminal inflorescences with appressed hairs to 0.8 mm long; near Miles **C. columboola**
- 2. Spikelets in terminal inflorescences with ascending hairs to 2 mm long; near Duaringa and Charters Towers **C. duaringa**

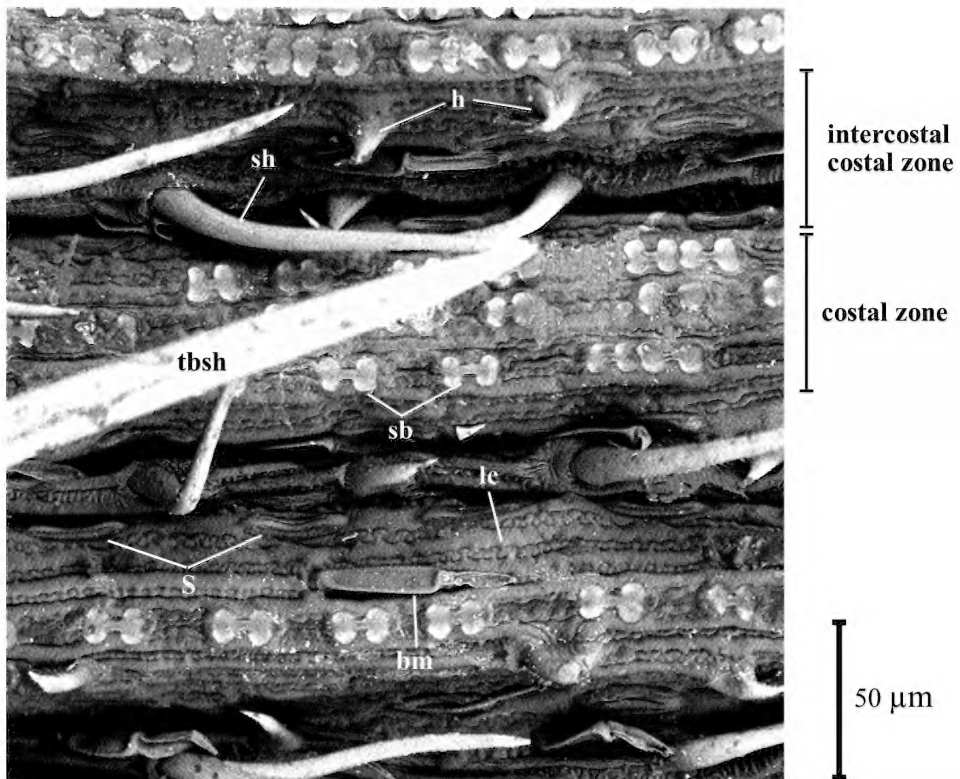


Fig. 6. Scanning electron micrograph of abaxial leaf surface of *Cryptachne trinerva*. From Thompson CHA555 & Turpin (BRI). Micrograph (captured at $\times 1000$): E.J. Thompson. **lc** anticlinal walls of long cells; **bm** bicellular microhair; **sb** silica body – bilobate type; **S** stomata; **sh** simple hair; **tbsh** tuberculate based simple hair.

1. *Cryptachne trinerva* E.J.Thomps., sp. nov.

Culms to 80 cm tall. Apical spikelets in terminal inflorescences mostly > 5 mm long; axillary spikelets mostly single and sessile, > 7 mm long. Spikelets in terminal inflorescences with ascending hairs to 1.2 mm long. **Typus:** Queensland. NORTH KENNEDY DISTRICT: 12 km W of Charters Towers near edge of Flinders Highway, 30 March 2011, E.J. Thompson CHA763, B.K. Simon & M. Edginton (holo: BRI [AQ863142, comprising 1 sheet]).

Calyptochloa sp. (Charters Towers E.J.Thompson+ CHA554); Simon *et al.* (2007); Thompson & Simon (2012: 636).

Dimorphochloa sp. (Charters Towers E.J.Thompson+ CHA554); Simon & Thompson (2013); Thompson (2021a, 2022a).

Perennial grass; culms 50–80 cm tall, clumps spreading to 100 cm across, copiously branched. Culm internodes with hairs to 1 mm long. Sheaths with hairs to 4 mm long. Ligule *c.* 0.3 mm long. Contraligule *c.* 0.2 mm. Leaf blades at mid-culm 20–50 mm long, 1.5–3.5 mm wide, hairs to *c.* 4 mm long. **Terminal inflorescence:** axes 20–50 cm long, 5–9-flowered. Apical spikelets 4.9–5.6 mm long (without awn), 0.8–1 mm wide, lateral spikelets 4.3–4.7 mm long; apical pedicels 3–7 mm long, lateral pedicels 0.2–1 mm long. Lower glume to 0.2 mm long. Upper glume

4.1–5.6 mm long. Lower lemma 4.3–5.6 mm long; pilose, hairs ascending to 1.2 mm long. Upper lemma 3.5–3.7 mm long, awn 0.7–1.5 mm long. Lodicule *c.* 0.3 mm long. Anthers 2.5–2.9 mm long. **Axillary inflorescence:** most commonly occurring as single sessile spikelet 7.3–8.5 mm long (without awn), 0.8–1.1 mm wide. Upper glume 5.6–6 mm long. Lower lemma 7.3–8.5 mm long, 0.7–1.1 mm wide. Upper lemma 5.6–6.8 mm long, awn 1–1.7 mm long; palea 5.3–5.7 mm long. Single pedicellate spikelet: 6–6.8 mm long. Paired spikelets: sessile, 5.9–6.7 mm long; pedicellate, 6.9–7.5 mm long (without awn), pedicels 9–22 mm long. Anthers *c.* 0.8 mm long. Caryopsis not seen. **Figs. 11 & 12.**

Additional specimens examined: Queensland. NORTH KENNEDY DISTRICT: 11 km SW of Charters Towers on edge of Flinders Highway, Mar 2002, *Thompson CHA555 & Turpin* (BRI); 11.6 km W of Charters Towers near edge of Flinders Highway, Mar 2011, *Thompson CHA771, Simon & Edginton* (BRI); 12 km W of Charters Towers, Apr 2000, *Thompson CHA554 & Thomas* (BRI); *ibid*, Mar 2012, *Thompson CHA792 & Simon* (BRI); *ibid*, May 2013, *Thompson CHA827 & Simon* (BRI). **Cultivated.** Ashgrove, Feb 2016, *Thompson MOR796* (BRI); *ibid*, Apr 2017, *Thompson MOR818* (BRI).

Distribution and habitat: *Cryptachne trinerva* is known from only a few localities near Charters Towers (**Map 1**). It grows in woodland of *Acacia shirleyi* or *A. catenulata* C.T.White, on slopes of jump-ups or “stony rises”, often dominating the ground cover with *Cleistochloa subjuncea* usually present. Associated shrubs include *Erythroxylon australe* F.Muell., *Beyeria viscosa* Miq. and *Prostanthera leichhardtii* Benth. Regional Ecosystems represented include 10.7.3a and b, and 11.7.2 (QRE 2020).

Phenology: Flowering December to June.

Etymology: Named after the lower lemma commonly being 3-veined.

Conservation status: *Cryptachne trinerva* is known from several, small and fragmented subpopulations in a very restricted landscape type. These are threatened by clearing for pasture development, quarrying and road works. A suggested conservation status for the species is **Endangered** based on criterion B2a (IUCN 2019) and a formal conservation status nomination will be made elsewhere.

2. *Cryptachne columboola* E.J.Thomps., **sp. nov.**

Culms to 80 cm tall. Apical spikelets in terminal inflorescences mostly *c.* < 5 mm long; axillary spikelets mostly pedicellate only, < 7 mm long. Spikelets in terminal inflorescences with appressed hairs to 0.8 mm long. **Typus:** Queensland. DARLING DOWNS DISTRICT: 23 km NE of Miles, 10 km NNE of Columboola, 26 March 2013, *E.J. Thompson EJT906 & B.K. Simon* (holo: BRI [AQ1021906, comprising 2 sheets]).

Dimorphochloa sp. (Miles E.J.Thompson EJT906): Bostock & Holland (2014); Thompson (2021a, 2021c, 2022a).

Perennial grass; culms 50–80 cm tall, copiously branched, clumps spreading to 50 cm across. Culm internodes with hairs to 1 mm long. Sheaths with hairs to 3.5 mm long. Ligule 0.3–0.4 mm long. Contraligule *c.* 0.1 mm long. Leaf blades at mid-culm 20–55 mm long, 1.5–3.1 mm wide, hairs to 1.1 mm long; proximal margins with hairs to 3.8 mm long. **Terminal inflorescence:** axes 20–30 mm long, 5–9-flowered. Spikelets 3.3–4.8 mm long (without awn), 1–1.2 mm wide; apical pedicels 2.5–3.6 mm long, lateral pedicels 0.2–0.6 mm long. Lower glume to 0.2 mm long. Upper glume 3.5–4.8 mm long. Lower lemma 3.5–4.8 mm long; hairs sparse, appressed, to 0.8 mm long. Upper lemma 2.9–3.4 mm long, awn *c.* 0.7 mm long. Upper palea 2.7–3.3 mm long. Lodicule *c.* 0.3 mm long. Anthers 2–3 mm long. **Axillary inflorescence:** Spikelets mostly present as pedicellate only; up to 5 per culm; 4.6–6.6 mm long, *c.* 0.8 mm wide. Upper glume 4.2–4.6 mm long. Lower lemma 5–6.6 mm long. Upper lemma 5–6.6 mm long, awn to 0.7 mm long; palea 4–4.7 mm long. Solitary subsessile to sessile spikelet rarely present, if present then 4.3–4.5 mm long. Paired spikelets: sessile 5.4–5.9 mm long; pedicellate 6.1–6.4 mm long, pedicels 1–10 mm long. Anthers 0.5–0.8 mm long. Caryopsis not seen. **Figs. 13 & 14.**

Additional specimens examined: Queensland. DARLING DOWNS DISTRICT: 23 km NE of Miles, Jun 2012, *Thompson EJT888* (BRI). **Cultivated.** Ashgrove, Apr 2017, *Thompson MOR820* (BRI); *ibid*, Apr 2017, *Thompson MOR821* (BRI).

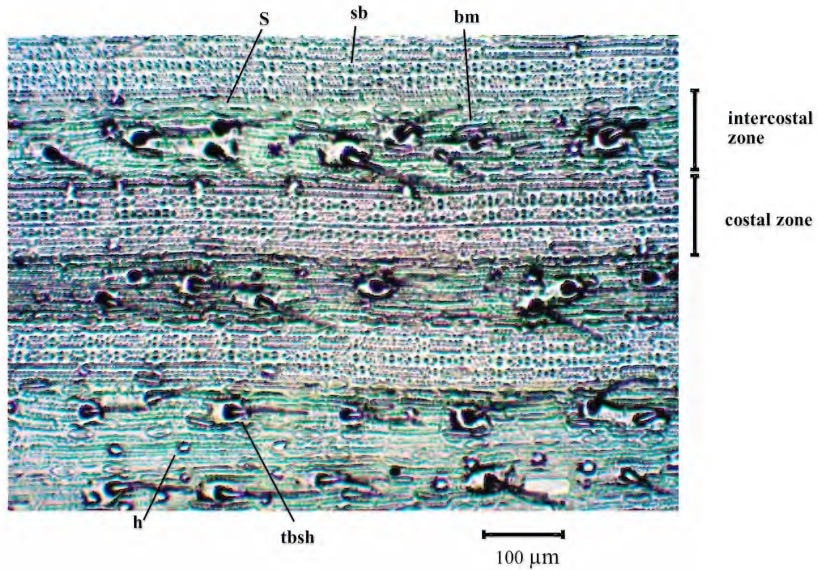


Fig. 7. Replica of abaxial leaf surface of *Cryptachne trinerva*. From *Thompson MOR796* (BRI). Photo: E.J. Thompson. **bm** bicellular microhair; **h** hook; **sb** silica body – bilobate type; **S** stomata; **tbsh** tuberculate-based simple hair.

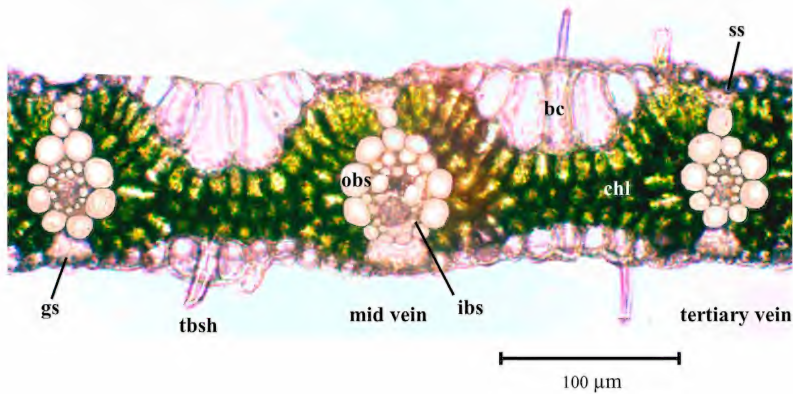


Fig. 8. Transverse section of fresh leaf at mid vein of *Cryptachne trinerva*. From *Thompson MOR796* (BRI). Photo (captured at $\times 20$): E.J. Thompson. **bc** bulliform cell; **chl** chlorenchyma; **gs** girder sclerenchyma; **ibs** inner bundle sheath – inverted ‘horse-shoe’ of thick-walled cells with adaxial clear cells; **obs** outer bundle sheath – ‘horse-shoe’ of clear cells with abaxial thick-walled cells; **ss** strand sclerenchyma; **tbsh** tuberculate-based simple hair.

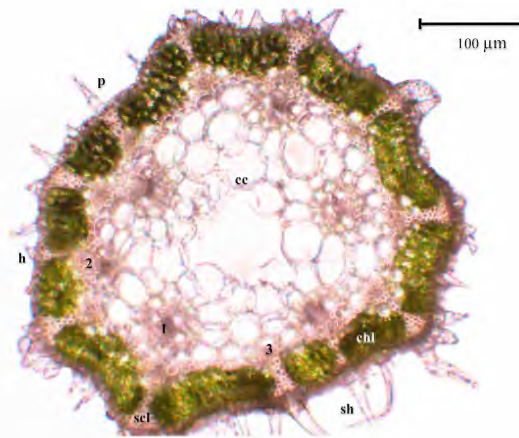


Fig. 9. Transverse section of fresh fertile culm of *Cryptachne trinerva*. From *Thompson MOR796* (BRI). Photo (captured at $\times 20$): E.J. Thompson. **cc** clear cells; **chl** chlorenchyma; **h** hook; **p** prickles; **scl** radial sclerenchyma; **sh** simple hair; vascular bundles: **1** primary; **2** secondary; **3** tertiary.

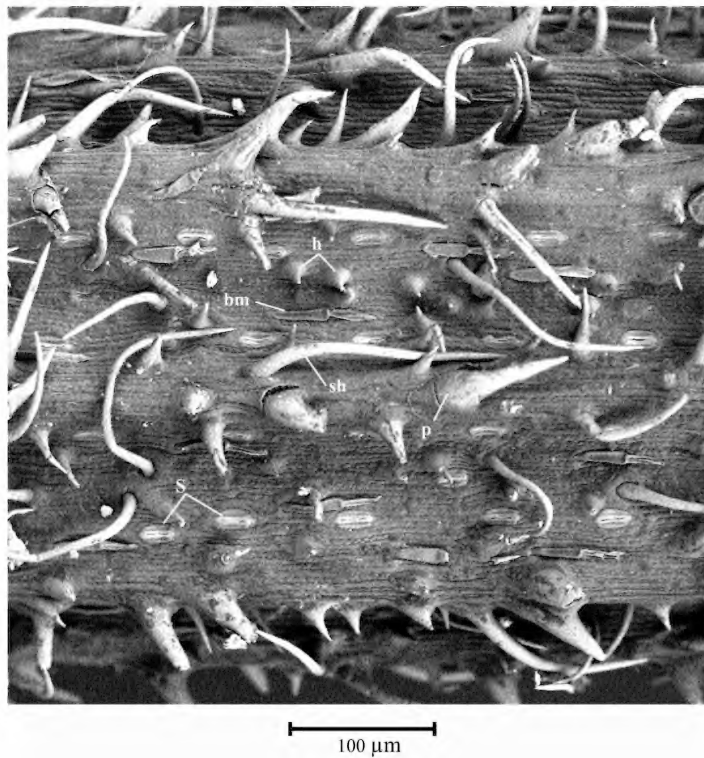


Fig. 10. SEM micrograph of surface of terminal inflorescence culm of *Cryptachne trinerva*. *Thompson CHA555 & Turpin* (BRI). Micrograph (captured at $\times 500$): E.J. Thompson. **bm** bicellular microhair; **h** hook; **p** prickles; **S** stomata; **sh** simple hair.



Fig. 11A. Holotype of *Cryptachne trinerva* (BRI [AQ1022169], sheet 1 of 2).



Fig. 11B. Holotype of *Cryptachne trinerva* (BRI [AQ1022169], sheet 2 of 2).

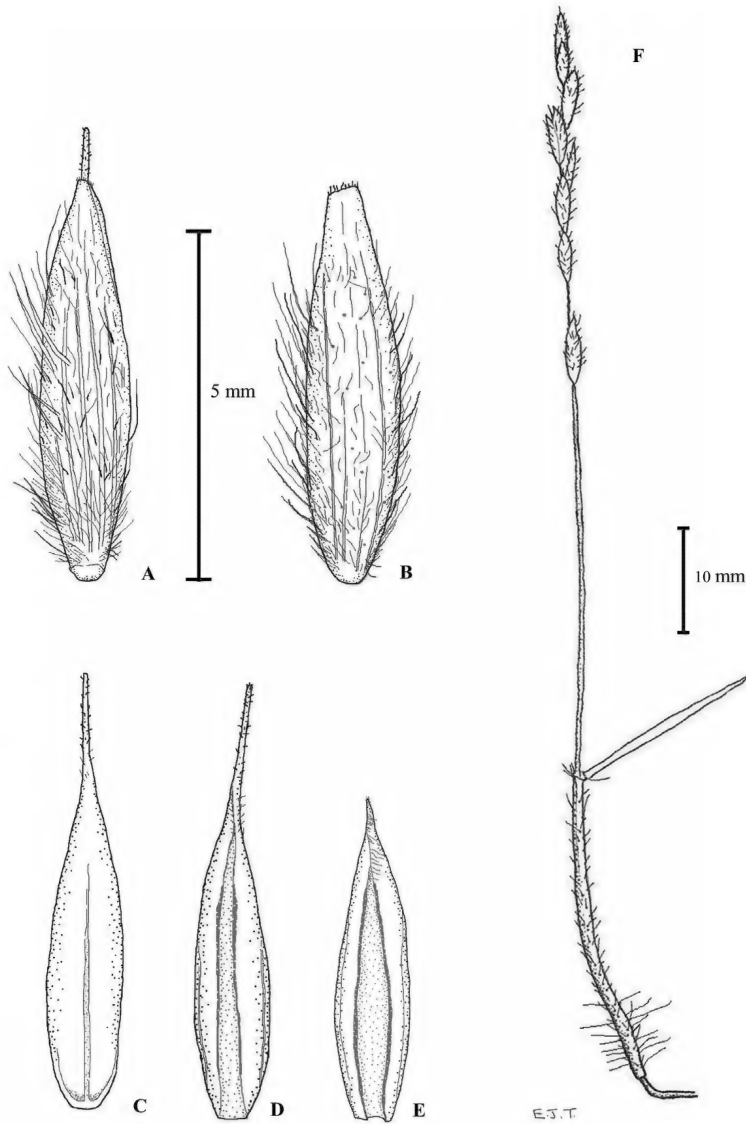


Fig. 12A. Terminal chasmogamous inflorescence and spikelets of *Cryptachne trinerva*. A–F. A. adaxial view of spikelet showing small lower glume and lower lemma. B. dorsal view of upper glume. C. dorsal view of upper lemma. D. ventral view of upper lemma. E. ventral view of upper palea. F. terminal raceme. All from *Thompson CHA555 & Turpin* (BRI), Del. E.J. Thompson.

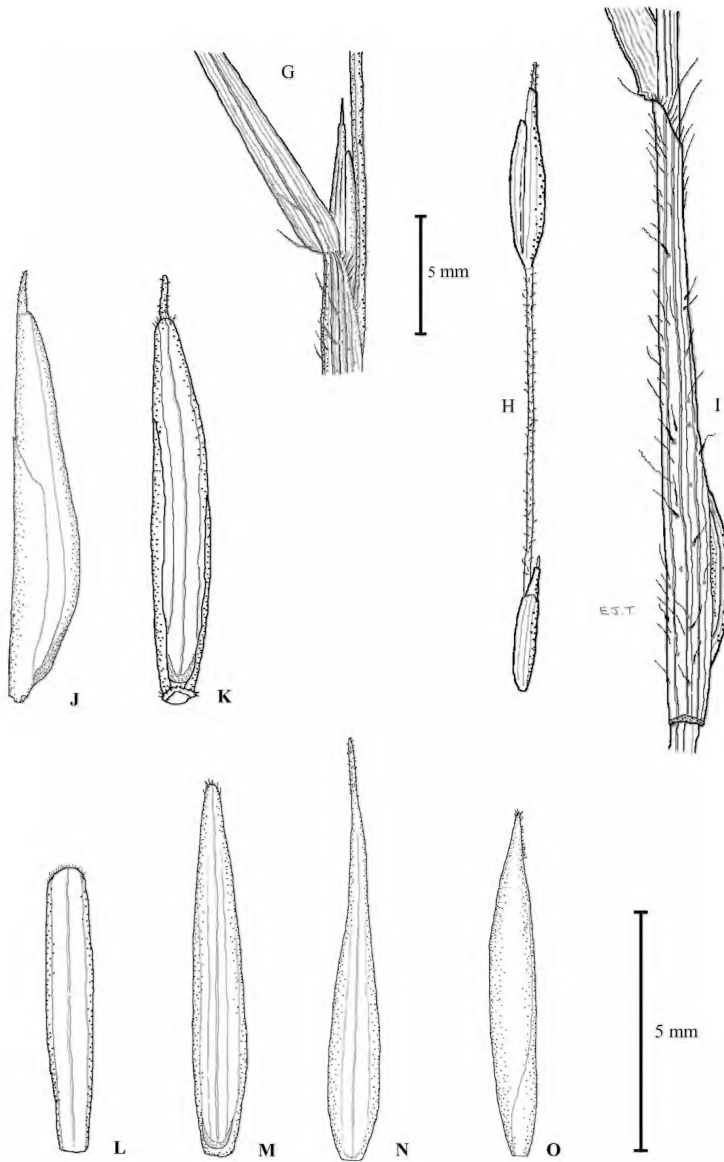


Fig. 12B. Axillary cleistogamous inflorescence and spikelets of *Cryptachne trinerva*. G. pedicellate spikelet *in situ*. H. paired spikelets, sessile and pedicellate with leaf sheath removed. I. sessile spikelet *in situ* showing bowed basal portion of culm internode. J–O. pedicellate spikelet. J. lateral view. K. adaxial view of spikelet showing lower glume and lower lemma. L. dorsal view of upper glume. M. dorsal view of lower lemma. N. dorsal view of upper lemma. O. ventral view of upper palea. All from Thompson *CHA555* & Turpin (BRI). Del. E.J. Thompson.



Fig. 13A. Holotype of *Cryptachne columboola* (BRI [AQ1021906], sheet 1 of 2).



Fig. 13B. Holotype of *Cryptachne columboola* (BRI [AQ1021906], sheet 2 of 2).

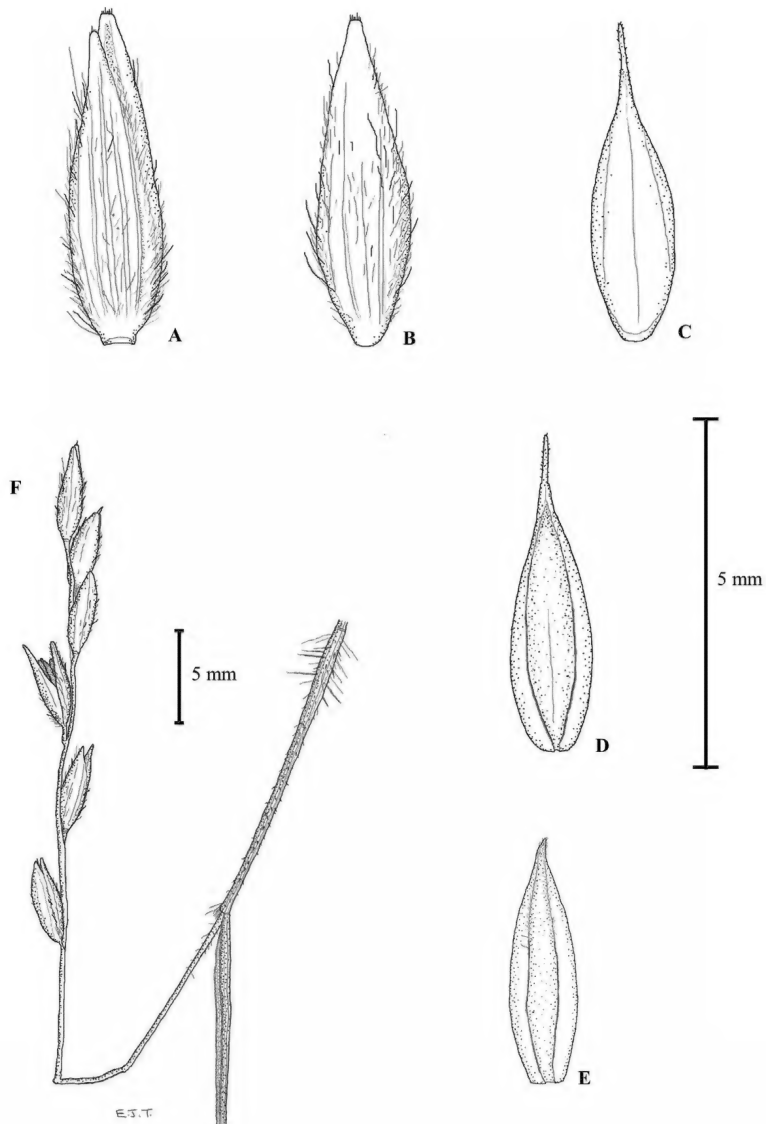


Fig. 14A. Terminal chasmogamous inflorescence of *Cryptachne columbola*. A. adaxial view of spikelet showing small lower glume and lower lemma. B. dorsal view of upper glume. C. dorsal view of upper lemma. D. ventral view of upper lemma. E. ventral view of upper palea. F. terminal raceme. All from Thompson EJT906 (BRI). Del. E.J. Thompson.

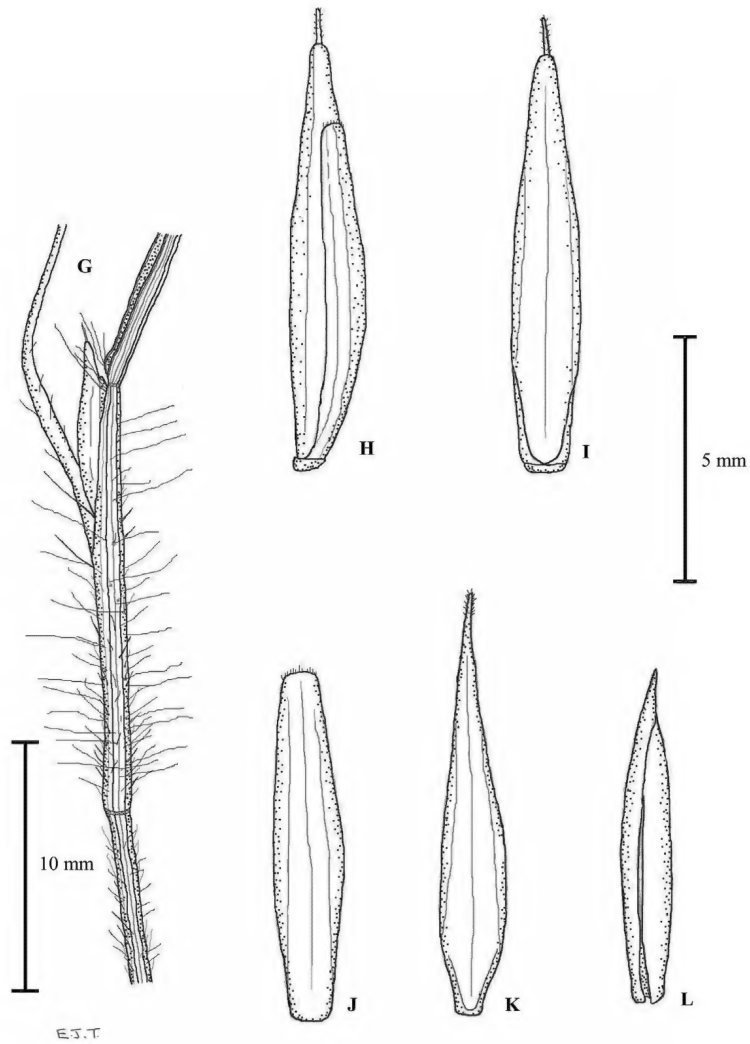


Fig. 14B. Pedicellate spikelet of axillary chasmogamous inflorescence of *Cryptachne columbola*. G. pedicellate spikelet, *in situ*. H. lateral view. I. dorsal view. J. dorsal view of upper glume. K. dorsal view of upper lemma L. ventral view of upper palea. All from *Thompson EJT906* (BRI). Del. E.J. Thompson.



Fig. 15A. Holotype of *Cryptachne duaringa* (BRI [AQ1022111], sheet 1 of 2).



Fig. 15B. Holotype of *Cryptachne duaringa* (BRI [AQ1022111]), sheet 2 of 2).

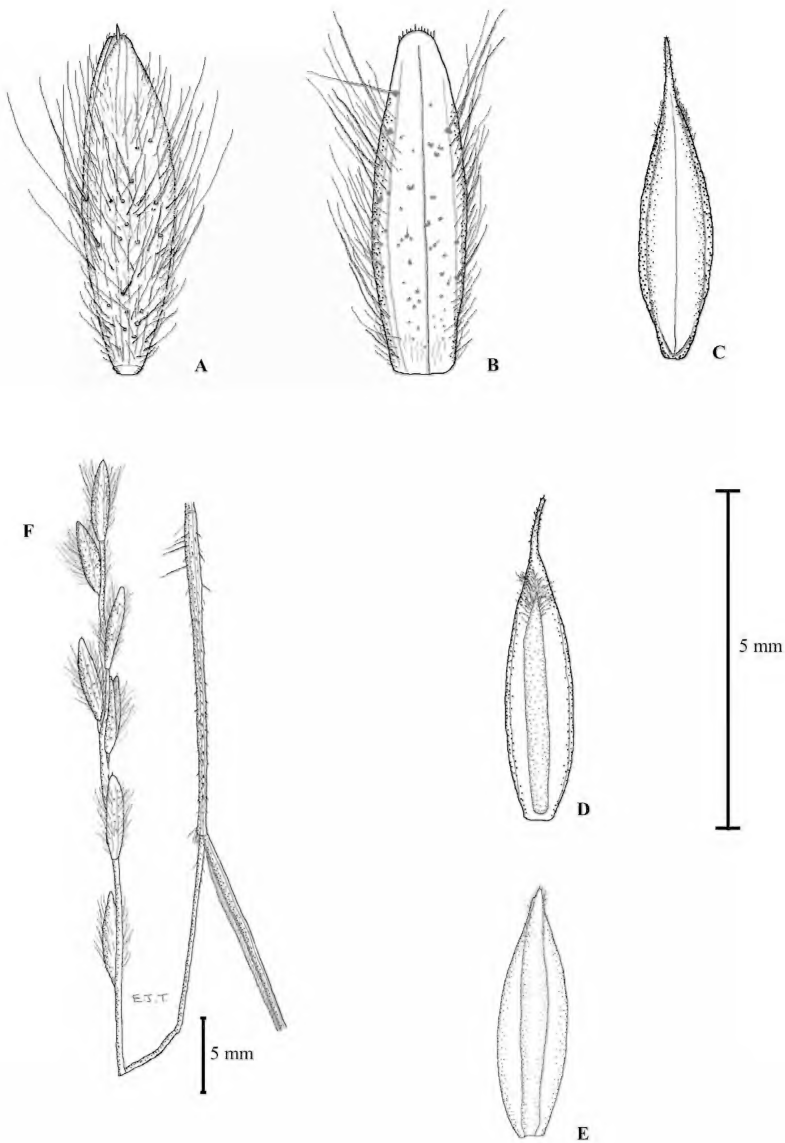


Fig. 16A. Terminal inflorescence spikelets of *Cryptachne duaringa*. A. adaxial view of spikelet showing small lower glume and lower lemma. B. dorsal view of upper glume. C. dorsal view of upper lemma. D. ventral view of upper lemma. E. ventral view of upper palea. F. terminal raceme. All from Thompson EJT931 & Simon (BRI). Del. E.J. Thompson.

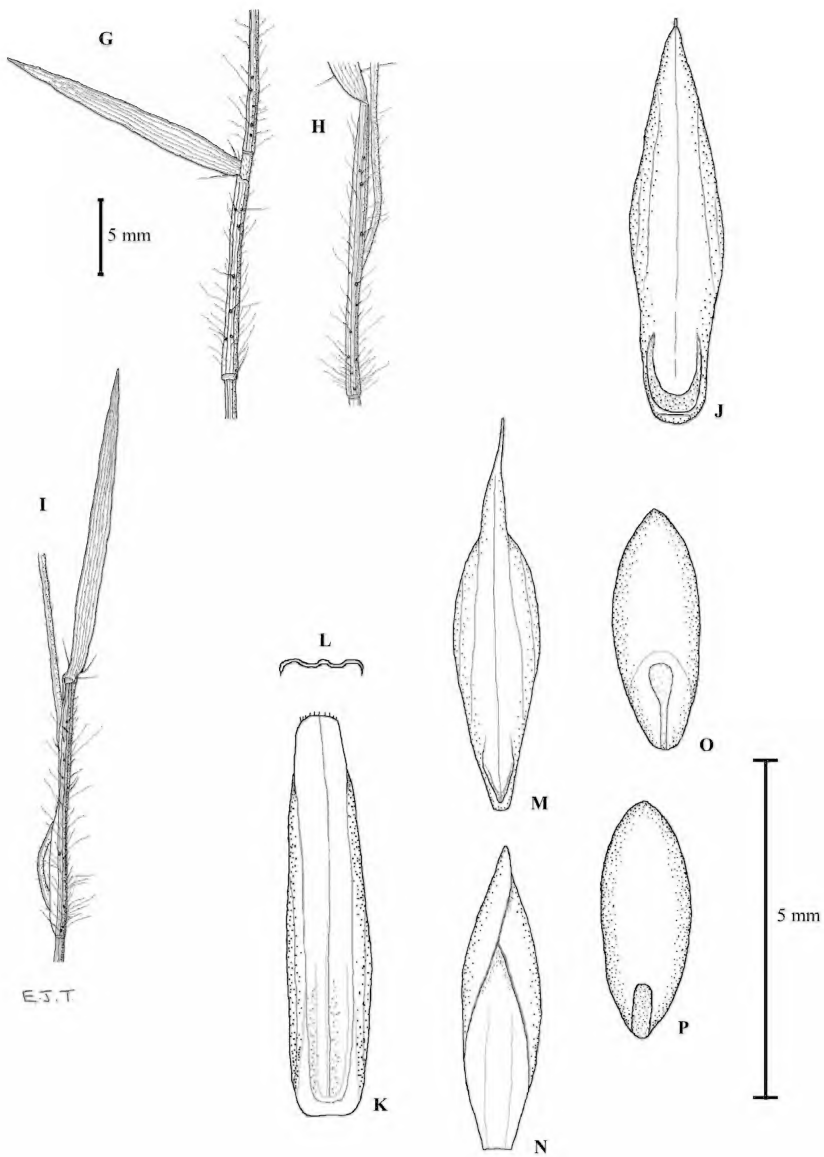


Fig. 16B. *Cryptachne duaringa*. G. sterile internode with leaf and sheath. J–P. Axillary inflorescence spikelets. J. lower lemma. K. dorsal view of upper glume. L. cross-section of upper glume. M. dorsal view of upper lemma N. ventral view of upper palea. O. ventral view of caryopsis showing scutellum. P. dorsal view of caryopsis showing hilum. All from *Thompson EJT931 & Simon* (BR1). Del. E.J. Thompson.

Distribution and habitat: *Cryptachne columboola* is known from a single location near Miles (**Map 1**). Plants occur in a woodland of *Eucalyptus fibrosa* F.Muell., on undulating terrain with sandy soil derived from duricrust. Regional Ecosystems represented include 11.7.7. (QRE 2020).

Phenology: Flowering December to June.

Etymology: The specific epithet is derived from the name of the location where the species was first discovered, near the small Queensland country town Columboola, in Barunggam country. The town is named after Columboola Creek, an Aboriginal word, meaning *plenty of white cockatoos* (<http://en.wikipedia.org/wiki/Coolumboola>, accessed 13 September 2021). The epithet is to be treated as a noun in apposition.

Conservation status: *Cryptachne columboola* is known from a single location in a landscape threatened by clearing for mining and pasture development. It is suggested that this species should be considered **Critically Endangered** based on Criterion B2a (IUCN 2019) with a formal conservation status nomination to be made elsewhere.

3. *Cryptachne duaringa* E.J.Thomps., sp. nov.

Culms to 60 cm tall. Apical spikelets in terminal inflorescences mostly *c.* < 5 mm long; axillary spikelets mostly pedicellate only, < 7 mm long. Spikelets in terminal inflorescences with ascending hairs to 2 mm long. **Typus:** Queensland. LEICHHARDT DISTRICT: Duarina State Forest, edge of Capricorn Highway, *c.* 10 km west of Duarina, 12 May 2013, *E.J. Thompson EJT931 & B.K. Simon* (holo: BRI [AQ1022111, comprising 2 sheets]).

Dimorphochloa sp. (Mt Cooper R.J.Cumming 18623); Simon & Thompson (2013); Thompson (2021a, 2021c, 2022a).

Perennial grass; culms 40–60 cm tall, clumps spreading to 100 cm across, copiously branched. Culm internodes with hairs to 1.3 mm long. Leaf sheaths with hairs to 5 mm long. Ligule *c.* 0.3 mm long. Contraligule *c.* 0.2 mm long. Leaf blades at mid-culm 20–55 mm long, 1.5–4 mm wide, hairs to 1 mm

long. **Terminal inflorescence:** axes 20–30 mm long, 5–9 flowered. Spikelets 3.2–5.2 mm long (without awn), 1.2–1.4 mm wide; lateral pedicels 0.2–0.6 mm long, terminal pedicels 3.5–5.4 mm long. Lower glume to 0.2 mm long. Upper glume 3.2–4.7 mm long. Lower lemma 3.2–5.2 mm long; pilose, hairs ascending, to 1 mm long. Upper lemma 3.2–5.2 mm long, awn 0.4–1 mm long. Lodicule 0.3–0.6 mm long. Anthers 2–3 mm long. Caryopsis 2.9–3.3 mm long, 1.1–1.3 mm wide. **Axillary inflorescence:** Spikelets mostly present as pedicellate only; up to 5 per culm; 5.4–6.9 mm long, 0.9–1.1 mm wide. Upper glume 4.9–6.2 mm long. Lower lemma 5.4–6.9 mm long. Upper lemma 5.4–6.9 mm long, awn 0.4–1 mm long; palea 4.9–5.1 mm long. Solitary subsessile to sessile spikelet rarely present, if present then 4.8–7.2 mm long. Paired spikelets: sessile 4.1–5.6 mm long; pedicellate 6.1–6.2 mm long, pedicels 1–10 mm long. Anthers 0.5–0.7 mm long. Caryopsis 3.6–4.3 mm long, 1.2–1.8 mm wide. **Figs. 15 & 16.**

Additional specimens examined: Queensland. NORTH KENNEDY DISTRICT: Mt Cooper Station – 80 km SE of Charters Towers, Mar 1999, *Cumming 18623* (BRI); 20 km SW of Charters Towers, May 2012, *Thompson CHA790 & Simon* (BRI); 81 km SE of Charters Towers on Mt Cooper Station, May 2012, *Thompson CHA822 & Simon* (BRI); 16 km SW of Charters Towers, May 2013, *Thompson CHA831 & Simon* (BRI). **Cultivated.** Ashgrove, Apr 2017, *Thompson MOR821* (BRI); *ibid.*, Apr 2017, *Thompson MOR819* (BRI); *ibid.*, Apr 2017, *Thompson MOR823* (BRI).

Distribution and habitat: *Cryptachne duaringa* is known from a few localities near Charters Towers and one location near Duarina (**Map 1**). Plants occur occasionally in a woodland of *Acacia shirleyi* or *A. catenulata* on slopes of jump-ups or “stony rises”. Regional Ecosystems represented include 10.7.3a and b, and 11.7.2 (QRE 2020).

Phenology: Flowering December to June.

Etymology: The specific epithet is derived from the name of the location where the species was first discovered near the Queensland country town Duarina, in Gangulu country. The town’s name is popularly speculated to be derived from the aboriginal words *D’warra D’nanjie* (*Duarininga*) meaning *a meeting*

place in the swamp oaks (<https://en.wikipedia.org/wiki/Duaringa>, accessed 13 September 2021). The epithet is to be treated as a noun in apposition.

Conservation status: *Cryptachne duaringa* is known from several small and fragmented subpopulations at only a few locations. These sites represent a very restricted landscape type that is threatened by clearing for pasture development. It is suggested that this species should be considered **Endangered** based on Criterion B2a (IUCN 2019) with a formal conservation status nomination to be made elsewhere. It has been recorded in a road reserve adjacent to Duaringa State Forest, but similar habitat occurs in the state forest, so it is likely to be present there.

Acknowledgements

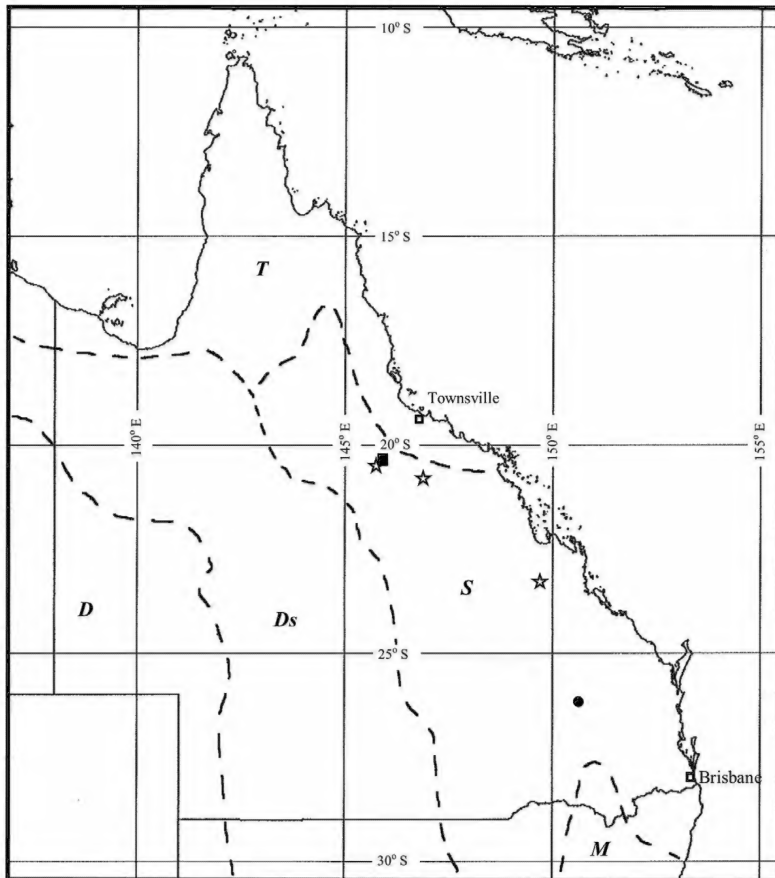
I am indebted to B.K. Simon for his mentoring in grass identification both in the field and in the herbarium over many years. Dr G.P. Guymer provided invaluable support at BRI.

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Legend

- | | | | |
|-----|----------------------------|---|-----------------------|
| — — | boundary of climatic zones | ● | <i>C. coolumboola</i> |
| T | equatorial to tropical | ☆ | <i>C. duaringa</i> |
| S | subtropical | ■ | <i>C. trinerva</i> |
| D | desert | | |
| Ds | semidesert | | |
| M | temperate | | |

Map 1. Distribution of species of *Cryptachne* based on BRI collection records. Climatic zones of Australia modified from BOM (2020) following Thompson (2021c).

Table 1. Major differences in morphological characters between *Cryptachne* and other genera in subtribe *Cleistochloinae*. Data obtained from Thompson (2021c)
 CH = chasmogamous, CL = cleistogamous.

Character	<i>Simonachne</i>	<i>Calyptochloa</i>	<i>Cleistochloa</i>	<i>Dimorphochloa</i>	<i>Cryptachne</i>
Growth habit	stoloniferous		rhizomatous		tufted, decumbent
Terminal inflorescence	reduced spike-like panicle	raceme	reduced spike-like panicle		raceme
Axillary inflorescence	raceme, usually 4 spikelets	raceme, 1 or usually 4 for one species	reduced raceme, 1 spikelet	reduced raceme apical on subordinate branches	reduced raceme, 1-2 spikelets
Terminal and axillary spikelets	similar	distinctly different	similar		distinctly different
Leaves disarticulating; relative duration of leaves	yes, photosynthesing in culms; long		yes, photosynthesing in culms; very short		
Contraflagule present	yes		no		yes
Spikelet compression	dorsi-ventral	strongly dorsi-ventral	dorsi-ventral		
CH spikelet indumentum	woolly	straight			
CH lower glume	small to vestigial				
Number of veins on the upper glume	7	7	5	absent	small
CH upper glume vs. the lower lemma length	subequal	longer	shorter	5-7	5
Indumentum on the CH upper glume vs. lower lemma	similar	dissimilar	subequal to equal		
Relative length of the upper lemma to the lower lemma	shorter	much shorter	similar		
Apex of CH upper lemma	mucronate	awned	mucronate		awned

Character	<i>Simonachne</i>	<i>Calyptochloa</i>	<i>Cleistochloa</i>	<i>Dimorphochloa</i>	<i>Cryptachne</i>
Germination lid on CH upper lemma	inconspicuous crescent-shaped depression between a raised portion of the two veins	conspicuous crescent-shaped depression between a raised portion of the two veins			
CH upper lemma with papillae	no	yes			
Orientation of CL spikelets	adaxial	abaxial		adaxial	
CL lower lemma with an elaiosome	absent	large	medium	small	
CL upper glume and lower lemma	chlorophyllous	with or without chlorophyll	lacking chlorophyll	chlorophyllous	
CH caryopsis:					
• Longitudinal	elliptical		elliptical	ovate	ovate
• Stylopodium	vestigial		narrowly fused	narrowly fused	vestigial
• Shape of scutellum	elliptical		elliptical	broadly elliptical	elliptical
• Surface pattern of pericarp	finely longitudinally striate	smooth	coarsely longitudinally striate		smooth
Radiate mesophyll	distinct	indistinct or incomplete		relatively distinct	